Value Added Products for SeaWinds on QuikSCAT

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Abstract— The *SeaWinds* scatterometer generates near real-time surface wind data over the global oceans. In order to make this data more accessible to non-governmental organization and individuals, the *SeaWinds* Value-Added Product (VAP) effort was initiated. Daily wind data is available to the public via the VAP website. Various data visualization techniques, such as merger with the more familiar geosynchronous cloud images and vector field animation, have been employed to make the *SeaWinds* data more accessible to a variety of users.

INTRODUCTION

In June of 1999, NASA's *SeaWinds* scatterometer was launched into orbit aboard the *QuikSCAT* spacecraft. A scatterometer is a radar instrument which measures surface wind speed and direction over the global oceans. In the case of *SeaWinds*, approximately 90% of the ocean surface is covered every 24 hours. Wind data derived from the SeaWinds instrument is used in oceanographical and meteorological applications.

Scatterometer wind data has proven invaluable to studies of weather and climate. Most of the Earth's surface is covered by ocean, and many of these ocean areas are remote from islands or shipping lanes. The ability to obtain the state of the winds in these areas has improved the fidelity of weather forecasting. For weather forecasting applications, of course, it is critical that the data be made available on a "near real-time" basis, or within 3 hours after data acquisition. This is accomplished with specialized SeaNRT (*SeaWinds* Near Real-Time) processors operating at both JPL and NOAA. This SeaNRT data is then distributed to organizations within the National Weather Service for input into numerical weather forecasting models and for use by "front line" forecasters, such as the National Hurricane Center.

The availability of global, near real-time wind products has provided a unique opportunity to expand the use of the data to non-governmental organizations as well. Such organizations include commercial weather forecasters, educational institutions, the media, and the general public. To foster the use of *SeaWinds* data in these sectors, the *SeaWinds* Value-Added Product (SeaVAP) effort has been established. At the SeaVAP website, any individual or organization can quickly obtain the latest wind data from the *SeaWinds* instrument on the *QuikSCAT* satellite. The web is the ideal distribution mechanism because of the criticality of obtaining weather data as near to real-time as possible – few are interested in yesterday's weather. The data are available in three primary formats: 1) For those with the interest to read them, the wind data are available in numerical format where latitude, longitude, wind speed, and wind direction are given, 2) Current surface wind vectors are merged with current geosynchronous cloud imagery from GOES-8, GOES-10, and GMS-5, 3) Wind field animations are produced to allow a more intuitive view of the synoptic picture. The data can be accessed at http://winds.jpl.nasa.gov.

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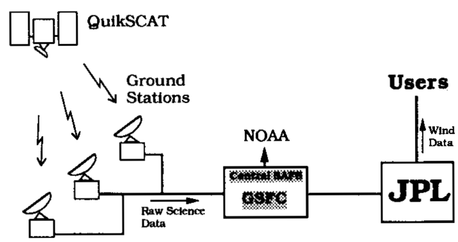

Figure 1: *VAP data flow.*

WIND VECTOR CLOUD OVERLAYS

One data visualization technique employed on the VAP site is to merge the *SeaWinds* data with the more familiar cloud imagery available from operational geosynchronous meteorological satellites. Images of co-located surface winds and cloud data allow users to quickly place the scatterometer data into a greater meteorological context.

The cloud overlays start with the all water pixels in the given scene of cloud data colored blue and all the land pixels color green. These colors are then converted to their Hue-Lightness-Saturation representation, with the Lightness and Saturation values discarded. The cloud data is scaled into the range [0,99] and used to modulate the light-

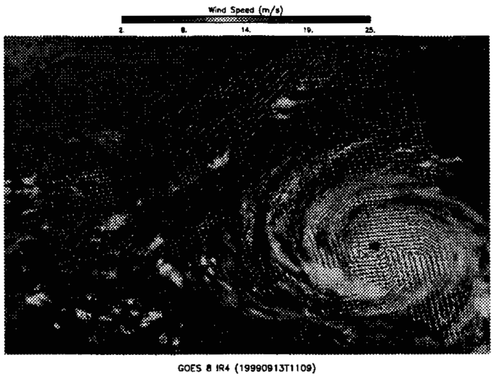

Figure 2: *Example cloud overlay showing hurricane Floyd with associated scatterometer surface wind field.*

ness and saturation values of each pixel. The saturation of each pixel goes inversely as the cloud value so that large cloud values are mapped to the gray scale and small cloud values map to the fully saturated color of the pixel. The lightness values go directly as the cloud value so that small cloud values are dark while large ones are white. Two configurable parameters each for Lightness and Saturation can be used to specify a Min/Max where the ramp for each goes to the constant Minimum/Maximum Lightness or Saturation.

The resulting image is warped to a cylindrical projection of the desired size, overlaid with the wind vectors and a JPEG file is output which is then posted to the web page. Scatterometer cloud overlays for selected Earth regions are updated twice daily corresponding to the ascending and descending passes of the *QuikSCAT* satellite through the area.

WIND FIELD ANIMATIONS

Data visualization techniques employing animation have been particularly successful with scatterometer data, illustrating features such as cyclonic circulations and fronts that are not as readily apparent in still images. Rather than produce time-lapse loop animations, such as that commonly seen on the TV weather forecast, the VAP system generates animations that effective represent a "snapshot" of the vector field. Thus the movement of the vectors indicates the direction and speed at a specific point in time. With the factor of two increase in coverage that will result when the second *SeaWinds* instrument is launched on the Japanese ADEOS-II spacecraft in November of 2001, true time evolution animations are expected to be possible.

On the VAP web page, fourteen hours of wind data is interpolated using the method of "successive corrections" to a 1 by 1 degree field over the entire world between +/- 60 degrees latitude. This interpolated field is then used to propagate an initial set of positions ("vectors") along the trajectory determined by this wind field. The animation is spun-up for 60 frames so that the first frame of the animation will show the structure of the wind field, i.e. areas of convergence and divergence. Each vector has a "time" value whose initial position is randomly distributed between 0 and number of frames - 1, which, for the web animations, is 60. For each frame this "time" value is incremented. When it reaches n_frames-1 that "vector" is reset to its starting position. Thus the last frame of the animation varies smoothly into the first and the animation can be looped without visible transition over the boundary between last and first frames. Each frame is written out and a shell script is called to convert the string of frames into a QuickTime movie which is then posted to the web.

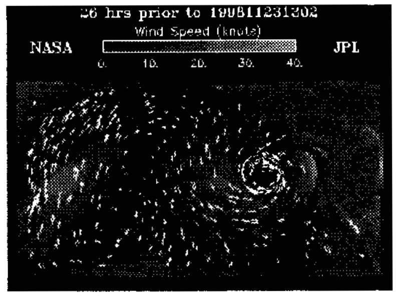

Figure 3: *Animation frame of North Pacific ocean showing mid-latitude storm system.*

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